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10/590,011	08/21/2006	Takeshi Hikata	070456-0119	7075
20277 7590 11/16/2011 MCDERMOTT WILL & EMERY LLP 600 13TH STREET, N.W. WASHINGTON, DC 20005-3096				
EXAMINER				
HORNING, JOEL G				
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**BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES**

Application Number: 10/590,011  
Filing Date: August 21, 2006  
Appellant(s): HIKATA, TAKESHI

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Bernard P. Codd  
For Appellant

**EXAMINER'S ANSWER**

This is in response to the appeal brief filed August 16<sup>th</sup>, 2011 appealing from the Office action mailed February 16<sup>th</sup>, 2011.

**(1) Real Party in Interest**

The examiner has no comment on the statement, or lack of statement, identifying by name the real party in interest in the brief.

**(2) Related Appeals and Interferences**

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

**(3) Status of Claims**

The following is a list of claims that are rejected and pending in the application:

The statement of the status of claims contained in the brief is correct.

**(4) Status of Amendments After Final**

The examiner has no comment on the appellant's statement of the status of amendments after final rejection contained in the brief.

**(5) Summary of Claimed Subject Matter**

The examiner has no comment on the summary of claimed subject matter contained in the brief.

**(6) Grounds of Rejection to be Reviewed on Appeal**

The examiner has no comment on the appellant's statement of the grounds of rejection to be reviewed on appeal. Every ground of rejection set forth in the Office action from which the appeal is taken (as modified by any advisory actions) is being maintained by the examiner except for the grounds of rejection (if any) listed under the

subheading "WITHDRAWN REJECTIONS." New grounds of rejection (if any) are provided under the subheading "NEW GROUNDS OF REJECTION."

**(7) Claims Appendix**

The examiner has no comment on the copy of the appealed claims contained in the Appendix to the appellant's brief.

**(8) Evidence Relied Upon**

6,858,197                                      DELZEIT                                      2-2005

Fan et al. Science, vol 283 (Jan 22, 1999), pages 512-514.

**(9) Grounds of Rejection**

The following ground(s) of rejection are applicable to the appealed claims:

**Claims 1 and 3-5** are rejected under 35 U.S.C. 103(a) as being unpatentable over Delzeit (US 6858197).

The instant claims are directed towards a catalyst structure *that is shaped as a pipe with its upper surface capable of serving as a crystal growth surface*, which can be used to make carbon nanotubes by vapor deposition, which includes a catalytic material which forms a ring on a crystal growth surface, *and at least part of a side of said pipe shaped structure has a non-catalytic material with substantially no catalytic activity with respect to a growth of said crystalline carbon.*

Delzeit is directed towards a catalyst structure for depositing carbon nanotubes by a vapor deposition method, which includes a surface with a layer of catalyst material which is formed into a desired pattern (abstract).

Delzeit further teaches that a catalyst structure having a multilayer catalyst material with an even surface and a first layer of aluminum (which is exposed on the outside of the structure and not taught to be catalytic), a second layer of catalytic iron, cobalt, or nickel covered by a third layer of catalytic molybdenum, can then be coated with an overlayer material (which puts it exposed on the outside [as shown each layer is exposed on the outside] as well as the top side of the catalyst structure, see figure 4) of silver (**claims 3 and 4**). This overlayer material is not taught to be catalytic and does not appear to contribute to catalysis, instead having the function of coating the outside of the grown nanotubes (col 4 line 57 through col 5, line 3). Additionally, since applicant claims that silver can be the non-catalytic material, it must have "substantially no catalytic activity with respect to a growth of said crystalline carbon." Hence the multilayer structure of the crystal growth surface is composed of catalytic (iron, cobalt, nickel and/or molybdenum) and non-catalytic (aluminum and silver) materials (**claim 5**).

Regarding the shape of the pattern, Delzeit further teaches that the structure of the catalyst can be formed into arrays (an assembly of a plurality of catalyst structures) by using masks with regular or irregular arrays of apertures. These apertures can each be formed into a wide variety of aperture patterns, shapes, even numbers or letters, such as the number 8 which is a two pipe structure, or zero, which would be a single pipe aperture (fig 2G, figure 3, col 4, lines 23-41).

Thus it would have been obvious to a person of ordinary skill in the art at the time of invention to create the multilayer molybdenum catalyst layer with the silver

non-catalytic layer on the top side of the structure in the shape of a pipe, which would make the catalyst in the shape of a ring, since these materials are explicitly taught to be suitable for the catalyst material and the shape is explicitly taught to be a suitable shape for the catalyst material.

Applicant requires that the catalyst ring correspond, in some way, to a carbon nanotube. However, since no particular carbon nanotube is being corresponded to it and no particular relationship for this correspondence is being claimed, this is open to broad interpretation. For instance, the diameter of the ring could correspond to the length of a carbon nanotube that is that length. Delzeit teaches that the carbon nanotube length depends upon the structure of the catalyst (col 1, lines 40-45), so the ring structure is taught to correspond to the length of the carbon nanotubes that are grown on it. Additionally, Delzeit teaches that the catalyst structure can be patterned small enough that only a single nanotubes may grow on it (col 6, lines 10-18). In that case, the catalyst structure will correspond to a single carbon nanotube that grows on it, also meeting the claim limitation (**claim 1**).

Furthermore, given the teaching of Delzeit of forming the catalyst into the shape of letters and numbers, it would have been readily apparent to a person of ordinary skill in the art at the time of invention to make the catalyst shape into any letter or number shape, including the letter "O" or the number zero, which are (along with many other numbers and letters) considered "pipe" shapes and would produce ring shaped catalyst layers (**claim 1 alternate basis**).

**Claim 6** is rejected under 35 U.S.C. 103(a) as being unpatentable over Delzeit (US 6858197) in view of Fan et al (Science vol 283, pages 512-514, (1999)).

The instant claim requires that the crystal growth surface of the catalyst be oxidized.

Delzeit teaches using iron as the nanotube catalyst (abstract), but does not teach oxidizing its surface.

However, Fan et al is also directed towards patterning and vapor deposition of carbon nanotubes (abstract) by selective deposition of iron as a catalyst material, which then has its surface oxidized (page 512, col 2, lines 1-10). Fan et al further teaches that the resulting iron oxide material acts as a suitable catalyst to decompose precursor vapors so that they then form carbon nanotubes (page 513, col 1, lines 1-5).

Thus it would have been obvious to a person of ordinary skill in the art at the time of invention to substitute the iron catalyst of Delzeit with the iron oxide catalyst of Fan as a known alternative catalyst material known to be suitable for the deposition of carbon nanotubes which would produce predictable results (**claim 6**).

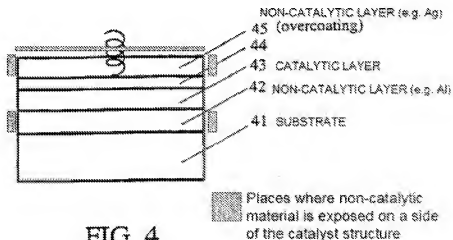
#### **(10) Response to Argument**

Applicant's arguments with respect to claims 1 and 3-6 have been considered but are not convincing in view of the new ground(s) of rejection necessitated by amendment.

Applicant first argues that depositing the catalyst material in a ring shape on the substrate surface is a pipe shape, but that shaping the layered structure into a

raised number "8" shape as taught by Delzeit would not be considered a pipe shape. However, the office's position is that the number "8" shape consists of two rings so it must be a double pipe and read upon the claimed shape. Additionally, as stated in the rejection, it is obvious to form the catalyst in other alphanumeric shapes, like the number "0" and the letter "O", which both are single ring shapes and are precisely the shape exemplified by applicant to be pipe shaped in figure 2C, so Delzeit both specifically teaches forming the catalyst into shapes that read on applicant's claimed "pipe" and renders obvious forming applicant's specifically pictured "pipe" shape.

Applicant then argues that Delzeit does not disclose having "at least a part of a side of the structure shaped as a pipe has a non-catalytic material." However, as described in the rejection, Delzeit does teach this. As shown below in a slightly modified figure 4 of Delzeit, the sides where non-catalytic material is exposed on at least a side of the catalytic structure is highlighted. In the catalyst where these layers have been patterned into a pipe shaped catalyst (e.g. number 8 or 0), these correspond to the outside, inside and top side of the pipe shape.





Applicant then argues that the layers shown in figure 4 appear to be rectangular shaped and are not pipe shaped. However, the examiner's position is that figures 4 and 5 are schematics to show how the structures are vertically layered, not particularly how they are horizontally patterned. It is readily apparent from this structure that when the structures are horizontally patterned (e.g. into a pipe shape), the vertically exposed surfaces of the catalyst material in the chosen pipe pattern will include exposed non-catalytic material (this is the case on the inside and outside of the pipe) and that the top exposed side of the structure will also include exposed non-catalytic material, reading upon the claims.

Applicant then argues that even if the examiner were correct about the catalyst structure being formed into a pipe shape, only the catalyst layer would be so patterned. However, Delzeit also teaches patterning the underlying non-catalytic "first" layer (which corresponds to 42 and 15) in addition to the catalyst layer (which corresponds to 43-44 and 17) (see col 2, lines 28-40 and 57-65 and col 4, lines 23-30). Additionally, when the non-catalytic overcoating layer is deposited onto the patterned topography it is readily apparent that it will also form a pipe shape. The argument is not convincing.

Applicant then argues that the catalyst layer is very thin and that there are no other materials in the catalytic structure of Delzeit. However, as discussed previously, there are other material layers present in the catalyst structure. The applicant has not claimed the thickness of the catalyst layers, so that information is not dispositive to this case.

Applicant additionally argues that the rejection of Delzeit in view of Fan is improper because of the supposed deficiencies argued above in Delzeit. Since these previous arguments are not convincing, the argument against Delzeit in view of Fan is not either.

**(11) Related Proceeding(s) Appendix**

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

/JOEL G HORNING/

Examiner, Art Unit 1712

/Michael Cleveland/

Supervisory Patent Examiner, Art Unit 1712

Conferees:

/SHRIVE BECK/

Supervisory Patent Examiner, Art Unit 1700

/Michael Cleveland/

Supervisory Patent Examiner, Art Unit 1712